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Laser Assisted Processing of Sensors on Metallize Films

One-step, low-cost alumina sensors embedded in packaging to monitor food moisture and spoilage.

Researchers at Purdue University have developed a method to create humidity sensors to monitor moisture levels in packaged goods. One of the major causes of food spoilage is the presence of excess moisture in the package of both fresh (i.e., fruits and vegetables) and dried products. Nearly one-third of all food produced for human consumption is discarded due to improper packaging and spoilage. Smart packaging technologies with integrated sensors that can monitor the quality of the product and the package reduces food waste by maximizing the shelf life of products and notifying consumers of accurate information about the packaged product. Although remote sensing and wireless communication approaches have been widely used for automobiles and agriculture, their use in packing goods is rare; it's not economically feasible due to the cost of components and fabrication process. Purdue researchers have developed a scalable and cost-effective process of manufacturing low-cost humidity sensors for wireless monitoring of moisture through selective laser ablation of metalized paper. In this process, the aluminum layer on the paper serves as both a highly conductive material for creating the circuit traces of the sensor as well as a precursor for creating moisture-sensitive, nanostructured alumina directly on the parchment paper substrate. The rapid laser processing technology and inexpensive materials used in this process allow the sensors to be fabricated economically, thereby making them suitable for disposable packaging applications in which the cost of production is crucial for the viability of the technology.

Technology Validation: The Purdue researchers' sensor has a 10-fold higher sensitivity to humidity than a similar LC resonant sensor prepared by conventional photolithography processes.

Advantages:

Technology ID
2022-RAHI-69719

Category
Agriculture, Nutrition, & AgTech/Food Safety & Traceability
GreenTech/Sustainable Packaging Materials

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- Low-cost

- Wireless

- One-step laser processing

- Battery free

- Electronic free

- Scalable

- Paper based sensors

Applications

- Remote and battery free humidity sensing in packaged products

TRL: 3

Intellectual Property:

Provisional-Patent, 2022-03-31, United States

Utility Patent, 2023-01-31, United States

CON-Patent, 2025-06-25, United States

Keywords: Food and Nutrition, Food Spoilage, humidity sensor, Materials and Manufacturing, Moisture, Nanomaterials, packaging, Remote Sensing, Scalable Laser Processing